The Direction of Science Versus String Theory, or, Were Albert Einstein's Guidelines for the Next Scientific Revolution Wrong?

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Abstract: There are scientists that have speculated that, since science involves abstraction, generalizations across facts, and the generalization of causes and theories across empirical phenomena, the direction of science is to increasingly unify forces and causes until there is a single general theory unifying all of the forces of nature. The most prominent contemporary example of this attempt to unify all of the forces of nature in a single theory is string theory or superstring theory. String theorists have attempted to emulate Albert Einstein's call for physicists to attempt to unify all of the forces of physics in a single theory, sometimes called a "theory of everything." I seek to show that, instead of attempting to unify all of the forces of nature in a single theory or "theory of everything," it is possible to identify and separate the forces of nature in relation to each other, and order and rank the forces of nature by their capacity to generate branching patterns in the biological sciences or the physical sciences. Ranking forces by their capacity to generate branching patterns (or other shapes or patterns), in the biological sciences or in the physical sciences, is more positivist and testable than attempts to unify all of the forces of nature in a single theory.

Keywords: String Theory; Einstein; positivism ; branching patterns

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1. **Introduction**: There are scientists that have speculated that, since science involves abstraction, generalizations across facts, and the generalization of causes and theories across empirical phenomena, the direction of science is to increasingly unify forces and causes until there is a single general theory unifying all of the forces of nature. Most famous among these is Einstein, and the most prominent contemporary example of this strategy is String Theory. String Theory or Superstring Theory attempts to unify all of the forces of physics, electromagnetism, gravity, and the strong and weak forces, in a single unified theory, and String Theory attempts to attach String Theory to particle physics.

String Theorists have attempted to follow Einstein's "quest" to unify all of the forces of nature: Post special relativity and general relativity, Albert Einstein's guidelines for the next scientific revolution in physics were in effect that physicists should attempt to unify all of the forces of nature in a single theory.

The *American Physical Society* comments that, "Einstein was motivated by an intellectual need to unify the forces of nature," and felt "strongly that all of nature must be described by a single theory."

The *American Physical Society* quotes Einstein: "The intellect seeking after an integrated theory cannot rest content with the assumption that there exist two distinct fields totally independent of each other by their nature."

The *American Physical Society* claims that, "Einstein established unification as an important goal of physics. Indeed a theory of everything is commonly called the 'holy grail' of modern physics."

String theorists, such as M. Suzuki, G. Veneziano, R. Brustein, M. Kaku, and others, have attempted to emulate Albert Einstein's "quest" to unify all of the forces of nature in a single theory, sometimes called a "theory of everything."

Possibly the most famous and influential protagonist of contemporary "theories of everything" is the physicist Edward Witten. Jim Holt, author of *When Einstein Walked*

with Godel, says that String Theorist Edward Witten is "widely regarded as the smartest physicist of his generation." Witten, in a recent review of his work, claims that "string theory has, even among theoretical physicists, the reputation of being mathematically intimidating." From Witten's standpoint, string theory is valuable because "string theory force(s) us to unify general relativity with the other forces of nature."

By comparison, Edward Witten states that standard quantum field theory, a potential alternative to string theory, "makes it so difficult to incorporate general relativity" with other forces of nature as Witten claims for string theory. Witten claims that quantum field theory is not as powerful as string theory: "Even though we do not really understand it, quantum gravity is supposed to be some sort of theory in which, at least from a macroscopic point of view, we average, in a quantum mechanical sense, over all possible spacetime geometries. (We do not know to what extent that description is valid microscopically.)" String theorist Andrew Strominger has co-published with Witten, P. Candelas, G. Horowitz, and others, and his contributions to String Theory include that, "the class of supersymmetric superstring compactifications has been enormously enlarged."

Strominger comments that string theory is a "potential unified theory of nature . . . string theory not only reconciles quantum mechanics and gravity, but can also contain within it electrons, protons, photons, and all the other observed particles and forces, and hence is a viable candidate for a complete unified theory of nature."

However, the *American Physical Society* comments that, "String theory has not yet made any testable predictions, and some scientists worry that string theorists have . . . strayed too far from physical reality in their obsession with . . . mathematics."

Nobel prize-winning physicist Sheldon Glashow has similarly commented that String Theory has not made "even one teeny-tiny experimental prediction."

Mathematical physicist Peter Woit, formerly a participant in String Theory, has stated that String Theory is "not even wrong," in his book *Not Even Wrong*. Peter Woit, in his *Not Even Wrong: The Failure of String Theory and the Search for Unity in Physical Law*, argues that String theory is not empirically testable, is "post-empiricist" from the standpoint of empirical science, and argues that String Theory has failed in its attempts to unify the forces of physics or to successfully attach String Theory to particle physics.

Moreover, it is questionable whether inventors or engineers have ever used String Theory and the physics of String Theory, a physics that attempts to unify all of the forces

of physics, electromagnetism, gravity, and the strong and weak forces, to design or engineer technologies or instruments, such as civilian or military vehicles, military weapons or weapons systems, buildings, houses, satellites, computers, space shuttles, cell phones, or other devices.

My work may introduce a new way of criticizing String Theory or other attempts to unify all of the forces of physics in a single theory. That is, instead of attempting to unify all of the forces of physics in a single theory, it may be more useful for positivism and predictive science to rank the forces of nature by their capacity to generate branching patterns or other fundamental shapes or patterns, and it may be more useful for technology, design, engineering, and computer science, to rank the forces of nature, in the physical sciences or the biological sciences, by their capacity to generate branching patterns or other fundamental shapes (such as wavelengths).

2. **Ranking Forces in the Biological Sciences**: Consider biology: In contrast with genetic mutation, gene duplication, recombination, and sexual reproduction (natural forces that increase the number and differentiation of characteristics across individuals in species), natural selection, in any generation, tends to decrease the number and differentiation of characteristics across individuals in species. Darwin and Wallace established the theory of evolution by natural selection, i.e., that given constant or near constant 'perpetuating' variations in the characteristics of individual organisms within the breeding populations of species, less favorable variations for survival and reproduction will be eliminated, and more favorable variations will be selected and retained.

As Darwin recognized natural selection is a conservative force that explains the gradual nature of evolution ("Natura non facit saltum"), and explains the conservation or retention of adaptive structures; thus, genetic mutation, gene duplication, sexual reproduction, and recombination are forces that tend to increase the number and differentiation of characteristics across individual organisms in any given generation in contrast with natural selection, and they tend to increase the rate of evolution in contrast with natural selection per se. However, natural selection may "increase" the rate of evolution over generations by conserving or retaining adaptive structures that facilitate an increase in the rate of evolution and species diversification, like the differentiation of forelimbs from hindlimbs, the retention of vertebrata, the retention of bilateral symmetry, the retention of sexual reproduction, the retention of the eye, the retention of warm blood, the retention of pollinating flowers, the retention of mammary glands, or the retention of organisms with larger and more complex brains.

The emergence of such adaptive structures are not generated by natural selection per se, but may be generated by forces such as genetic mutation, gene duplication, sexual reproduction, and recombination, in conjunction with natural selection (or in conjunction with natural selection and assortative mating). What, then, shapes and organizes biological variation? What shapes and organizes biological variation as branching patterns or branching geometries of characteristics and adaptive properties in the evolution of species?

Natural selection is constantly shaping and organizing branching patterns of characteristics across individual organisms in species across generational time; however, assortative mating may generate larger branching patterns or branching geometries of characteristics across individual organisms in species than natural selection on its own: Angiosperm plants that participate in interspecific assortative mating with bee species, insect species, and bird species have greater branching geometries of characteristics than ancestral species of plants or non-flowering plants that do not participate in interspecific assortative mating with insect species, bee species, and bird species; Species in the Genus *Homo* that participate in intraspecific assortative mating, including the human species, have greater branching geometries of characteristics, including behavioral characteristics and the expression of intelligences and personality characteristics, than primate species. (Intraspecific assortative mating is less in primate species since assortative mating within a shared language is absent in primates, and assortative mating across cultural characteristics is absent or far less compared to humans or even primordial species in the genus *Homo*).

Branching patterns are fundamental to science, their simulation in computer science, and many phenomena are considered or classified as branching patterns, including the electric discharges, crystals and crystal lattices, the tree of life, the differentiation of cells across cell lines and cellular growth in tissues, organs, and organisms, branching patterns of characteristics across individual organisms, branching patterns of characteristics and adaptive structures across species, and also languages and linguistic groups, religions and religious sects, “branches” of science and philosophy, and families, organizations, and human societies.

2.1 Identifying Branching Patterns, Visualizing Branching Patterns, and Assortative Mating: It is possible to compare populations of clones or genetic identicals to natural populations to reduce or collapse the distribution of characteristics of the natural population: In the human species, if an individual taken at random was cloned to produce a population of clones, it is possible to predict that the distribution of characteristics of the natural population of the species would collapse or reduce in the population of clones: that is, the number and differentiation of faces and facial characteristics, body types (i.e., ectomorphs, mesomorphs, and endomorphs) and physical characteristics, and behavioral characteristics, intelligences, personality characteristics, and talents, would collapse in the generation of clones. From the standpoint of evolution, it is possible to recognize that human evolution itself involves increasing the quantities that are collapsed or reduced in the population of clones: faces and facial characteristics, body types and physical characteristics, behavioral characteristics including the expression of intelligences, talents, and personality characteristics, and also the degree of assortative mating across individuals (i.e., there is more assortative mating, mating across categories of similar characteristics and categories of dissimilar characteristics, “like with like” or mating across complementary characteristics, “opposites attract,” than in a population of clones).

Thus, it is also interesting to recognize that assortative mating is identified as a variable, and that assortative mating has been increasing in the evolution of the Genus *Homo*; by contrast, natural selection as a force of evolution is commonly treated as a constant across primates, or primordial human species, or the human species. That is, natural selection is stated to explain the evolution of primate species; natural selection is stated to explain the evolution of primordial species in the Genus Homo; natural selection is stated to explain the evolution of the human species; natural selection is stated to explain the evolution of angiosperm species; natural selection is stated to explain the evolution of non-flowering plant species and ancestral species of plants. Thus, natural selection, as a force of evolution, is treated as a constant or near constant across species of organisms.

There is an analogy between (intraspecific) assortative mating in the Genus *Homo* and (interspecific) assortative mating amongst angiosperm plant species: Interspecific assortative mating may increase the size of the branching patterns or branching geometries of characteristics in the co-evolution of angiosperm species or flowering plants

with bee species, insect species, and bird species; by contrast, interspecific assortative mating is absent or far more limited between non-flowering plants and bees, insects, birds or other organisms.

Thus, it is possible to recognize that interspecific assortative mating has been increasing in the co-evolution of angiosperms, and bees, insects, and birds, and that the number of insect species and bird species that co-evolve with flowering plants has been increasing in the evolution and diversification of angiosperm species. (Wilson estimates that angiosperm species make up approximately one-sixth of all species that have been described, and it is estimated that 80-90% of all plant species are angiosperm species; insect species consist of approximately two-thirds of all species described; not all insects are pollinators, though pollinators are taken from orders Hymenoptera, Diptera, Lepidoptera, Coleoptera, and also a small though substantial number of pollinating bird species).

Moreover, it is possible to recognize that assortative mating may increase the rate of evolution more than natural selection on its own, since angiosperm species have faster rates of evolution than ancestral species of plants (e.g., ferns) or non-flowering plants; interspecific assortative mating also may play a role in increasing speciation and biological diversity more than natural selection on its own, given the large diversity of bee species, insect species, and bird species that have co-evolved as pollinators to different flowering plants. The nature of speciation and its large literature is not the focus of this section on ranking forces of nature in the biological sciences, including assortative mating as a force of evolution; however, it should be recognized that conventional models of speciation emphasize allopatric speciation, or speciation by physical or geographic barriers and genetic drift: 'Since most species originate as geographical isolates, one should expect that a certain percentage of such isolated populations are on the borderline between subspecies and species'; 'Allopatric models of speciation emphasise the role of geographical separation in achieving reproductive isolation between populations, and are currently considered to be the best candidates for understanding most speciation events.' Philosopher Jim Holt quotes Wittgenstein that, "there can never be surprises in logic."

However, rainforests have the greatest species diversity and the greatest number of species per unit area, which implies that speciation is more frequent generations

compared to generations in the physical proximity of high resource available environments of rainforests compared to speciation that occurs as a result of physical and geographic barriers; in addition to simple resource and nutrient availability, assortative mating may play a role in increasing the capacity for speciation across terrestrial and marine environments more than natural selection on its own, and thus assortative mating, in addition to simple resource and nutrient availability, may a play a role in increasing adaptive radiation across species more than natural selection on its own; in the human species, culture is partly analogous to resource and nutrient availability in terms of its synergy with assortative mating to increase the branching patterns of characteristics and adaptive properties across individuals in the human species, i.e., large cities may be likened to 'lush rainforests of culture'; the increasing number and differentiation of physical and behavioral characteristics across human populations are analogous to the adaptive radiation of characteristics and adaptive properties across species, especially angiosperm plant species that participate in assortative mating with bee species, insect species, and bird species).

2.2 *Branching Patterns, Natural Selection, Assortative Mating*: In contrast with natural selection, a theory of assortative mating predicts that the size of the branching patterns or branching geometries of characteristics across angiosperm species that co-evolve with and participate in assortative mating with bee species, insect species, and bird species are larger than the branching patterns of characteristics of ancestral species of plants or non-flowering plants (that do not participate in such interspecific assortative mating). Similarly, a theory of intraspecific assortative mating predicts that the size of the branching patterns or branching geometries of characteristics across individual members of a species are greater in species with more intraspecific assortative mating than in species with less, i.e., humans compared to primates; thus, in contrast with the theory of natural selection, a theory of intraspecific assortative mating predicts that the size of the branching patterns of characteristics across individual organisms in the human species will be larger than than the distribution of characteristics across individual organisms in primate species; as suggested, natural selection is commonly treated as a constant across primate species, proto-human species in the genus *Homo*, and *Homo Sapiens*.

2.3 *Assortative mating, Gene Duplication, and Branching Patterns*: As suggested, natural selection shapes branching patterns of biological characteristics and adaptive

properties; however, assortative mating and natural selection may shape larger and more diverse branching patterns of characteristics and adaptive properties than natural selection on its own.

It also may be possible to assimilate the influential work of Susumu Ohno to this approach: Susumu Ohno suggests that gene duplication is more important for the emergence of new gene functions than point mutations and mutations at the level of genes and alleles. Gene duplication is analogous to cloning, and it is possible to re-state Ohno's conjecture in a new way. Ohno's view is in effect that the differentiation of gene functions by gene duplication and genome duplication is greater than by genetic mutation per se (i.e., point mutations or mutations affecting the expression the individual genes and alleles).

From this standpoint, *gene duplication produces branching patterns in the evolution of species*, i.e., the differentiation of gene functions by gene duplication and genome duplication generates branching patterns of (new) adaptive structures in the evolution of species (in conjunction with natural selection, or in conjunction with natural selection and assortative mating, as discussed earlier).

Gene duplication and whole genome duplication events are viewed as being responsible for the emergence various adaptive structures in the evolution of species, including vertebrata in the evolution of vertebrates, the eye, and the emergence of structures available for pollination in angiosperm plants. Ohno's work may be re-formulated: the differentiation of gene functions by gene duplication and genome duplication is greater than by genetic mutation per se, and *the emergence of branching patterns of adaptive structures in the evolution of species are greater by gene duplication and genome duplication than by genetic mutation on its own*.

Generation per generation, genetic mutation and genetic recombination may contribute more to the Darwin-Wallace pattern of constant or near constant slight variations across individual organisms than gene duplications or whole genome duplication events (that are sometimes the products of recombination events); however, gene duplications and whole genome duplications may produce larger branching patterns of characteristics than genetic mutation on its own.

Thus, to incorporate Susumu Ohno's work to this perspective, gene duplication and whole genome duplication events have a greater capacity to generate branching patterns than genetic mutation on its own. This also may be restated: gene duplication and whole genome duplications events have a greater capacity to generate branching patterns of characteristics in the evolution of species than genetic mutation and natural selection on their own (genetic mutation and natural selection were the classic factors of evolution in early 20th century Anglo-American biology). Similarly, *sexual reproduction and recombination have a greater capacity to generate branching patterns of characteristics across individual organisms in species, and in the evolution of species, than asexual reproduction of organisms*.

2.4 *Cloning and branching patterns*: It is an interesting question of how to assess the capacity of cloning to produce branching patterns. Sexual reproduction and recombination have a greater capacity to produce branching patterns of characteristics across individual organisms in species in generational time than the asexual reproduction of organisms, and sexual reproduction and the alternation of generations have a greater capacity to generate branching patterns of characteristics across individual organisms in species, and in the evolution of species, than asexual reproduction. However, cloning produces branching patterns when there are multiple lines of clones that may be differentiated across functions, as in multiple cell lines that differentiate into the different cell types, tissues, organs, and adaptive structures of complex organisms; more limited cases compared to cellular differentiation of complex organisms are the multiple kinds of cloned individuals and castes of some eusocial insects that fulfill different functions across the eusocial organism. (Not all eusocial insects involve clonal castes; major transitions of evolution have included new cell lines and new cell types that have emerged as new adaptive structures in the evolution of species, and also new castes of individual members in the emergence of eusocial species).

2.5 *In principle, if it is possible to collapse or reduce a branching pattern or other fundamental shape or pattern by cloning, it is possible to identify and increase the quantities reduced by cloning*: Cloning organisms is a technical achievement that has been introduced in 20th and 21st century biology. It is thus possible to consider comparisons of populations of clones to natural populations from which the clones are derived or modeled: In the case of an individual organism taken at random from a natural

population of a species to produce a population of clones (such as 1,000 or a 1,000,000 or more), it is possible to predict that the distribution of characteristics of the natural population will collapse or reduce in the population of clones.

(It is interesting to consider if there are any exceptions to this prediction across the natural populations of species: a possible exception or set of exceptions is if the individual organism selected to be cloned is not an individual organism at random; instead, a possible exception or set of exceptions is if the individual organism is a kind of superindividual or superorganism that has a number of latent capacities or characteristics that approached or possibly exceeded the capacities, talents, or adaptive characteristics in the distribution of characteristics -- including behavioral characteristics in the case of the human species -- of the natural population from which the clone was taken or derived).

More generally, as suggested, it is possible to predict that, selecting an individual organism from any species, and cloning them to produce a population two or more (or a 1,000 or a 1,000,000 or more), will collapse or reduce the distribution of characteristics of the natural population of any species from which the population of clones are taken, derived, or modeled.

In many cases that distribution of characteristics is a branching pattern, as in the distribution of characteristics across individual organisms in biological species. Thus, cloning to produce a population of clones collapses the branching pattern or branching geometry of characteristics of the natural population from which the population of clones are derived, taken, or modeled.

However, it is logically possible that the distribution of characteristics or quantities of a natural population may be other shapes or fundamental patterns instead of branching patterns per se; as suggested, selecting an individual unit from a natural population and cloning them collapses the distribution of characteristics of the natural population.

Since cloning collapses or reduces the shape or shapes of the distribution of characteristics of the natural population, then it may be possible to conceive of how to increase the quantities and forces involved in maintaining, growing, or developing the shape or shapes of the distribution of characteristics or quantities of the natural

population (i.e., if it is in principle possible to reduce a set of characteristics or quantities, then it may be possible to increase the characteristics or quantities or identify how to increase them). Thus, the technique of comparing populations of clones to natural populations is a technique that may be used to collapse or reduce the distribution of characteristics of the natural population from which the clones are derived or taken; in principle, since the technique of cloning collapses or reduces the distribution of characteristics of the natural population, which is many times a branching pattern of characteristics, but may be another shape or pattern in the biological sciences or physical sciences, it is in principle possible to increase the quantities reduced in the population of clones and identify the forces involved in establishing the branching pattern or or other shape or pattern of the natural population from which the clones are derived.

An example is selecting an individual organism at random from the natural population of human beings, and cloning them to produce a population of clones. In the population of clones, the number and differentiation of characteristics across individual organisms reduces or collapses (facial characteristics, physical characteristics, behavioral characteristics including intelligences, talents, and personality characteristics; the capacity for assortative mating also reduces); that is, the distribution of characteristics of the natural population collapses or reduces, and thus also the shape or shapes of the distribution of characteristics of the natural population collapses or reduces, which is a branching pattern or branching geometry of characteristics across individual organisms of the human species.

The logic of the comparison of clones to the natural population of the human species may be reversed: Human evolution itself involves increasing the number and differentiation of faces and facial characteristics, physical characteristics and body types, behavioral characteristics, including intelligences, talents, and personality characteristics, and also assortative mating; that is, human evolution itself involves increasing the geometrical area of characteristics of the human species that are reduced or collapsed in a population of clones.

What are the processes or factors involved in increasing the number and differentiation of characteristics across individual organisms in the human species? That is, what are the processes or factors involved in increasing the geometry of characteristics

of the branching pattern or branching patterns of characteristics across individual organisms in the evolution of the human species? Is the only force involved Darwinism or natural selection? A new explanation is assortative mating: Intraspecific assortative mating in the evolution of the human species may generate larger branching patterns of characteristics across individual organisms in the human species than natural selection on its own. What increases assortative mating in the human species? Culture. Culture increases the number of qualities across individuals in human societies: Human societies have vastly more culture than primate societies; that is, human societies may have secular culture and religious culture, God, gods, goddesses, dance, music, science, philosophy, literature, fashion, cuisine, viticulture, horticulture, the arts, theatre, film, or other cultural phenomena; human societies have a differentiation of roles in the division of labor (or divisions of labor) that have the capacity to increase and diversify with increases in culture and material culture or technology, such as in hunting, horticulture, agriculture, warfare, or industry, or in families, groups, organizations, or the larger economy; human societies have an increasing differentiation of roles, experts, and specializations as material culture or technology diversifies and increases across organizations and society.

Thus, since culture increases the qualities across individuals in the human species, culture in human societies increases the capacity for assortative mating across categories of similar characteristics ('like with like') and categories of dissimilar characteristics ('opposites attract' or mating across complementary characteristics) more than in primate societies.

2.6 *Alternatives to Darwinism as a 'Design Process'*: It has not escaped the notice of the present author that, since Darwinism or natural selection has been used as a design model or 'design process' in biologically inspired computing, robotics and computer science to generate patterns, artificial intelligence, and the retention of machine learning, in principle, assortative mating may be used as an alternative model or design process in robotics and computer science for the generation of patterns, artificial intelligence, the performance of simulations, and the generation of different types of machine learning; moreover, the framework of ranking forces by their capacity to generate branching patterns, or the development of techniques or standards for ranking different branching patterns themselves, also may generate new models for generating patterns, artificial

intelligence, and machine learning in computer science and robotics. An additional potential consequence of this strategy is ranking computer science programs, applications, and algorithms in robotics and artificial intelligence by their capacity to generate branching patterns of capacities and intelligences (instead of strategies that attempt to simulate Darwinism or natural selection in artificial intelligence and robotics, or focus only on a single intelligence or capacity instead of multiple intelligences and capacities).

2.7: *Review of Ranking Forces of Nature in the Biological Sciences by their Capacity to Generate Branching Patterns:*

It is thus possible to consider ranking forces of nature by their capacity to generate branching patterns or other fundamental shapes or patterns. This strategy is different than attempts by String Theorists, Einstein, or others to unify the forces of nature in a single theory; it is also different than philosophical attempts to reduce all phenomena to the most basic or elementary constituents of matter, as in different kinds of reductionism and "physicalism," (as opposed to emergent phenomena at different levels of reality, including emergent causes of forces at different levels of reality). In the biological sciences, it may entail ranking forces of nature by their capacity to generate branching patterns of characteristics and adaptive properties in the differentiation of cells and cell lines, cellular growth, and the evolution of species; it also may entail ranking forces of nature by their capacity to generate the Darwin-Wallace pattern of constant or near constant 'perpetuating' variations across individual organisms.

Thus, assortative mating may generate larger and more diverse branching patterns of characteristics and adaptive properties than natural selection on its own, as in the evolution of angiosperm species compared to non-flowering plants and ancestral species of plants, the human species compared to primates (and, in principle, bird species compared to reptile species, and dolphin and whale species compared to fish species). Since natural selection is treated as a constant or near constant as a force of evolution across species, natural selection may be said to generate a larger set of branching patterns of characteristics and adaptive properties in the adaptive radiation of species than patterns of interspecific assortative mating (angiosperm plants and bee species, insect species, and bird species), or intraspecific assortative mating (the human species

compared to primates, bird species compared to reptile species, or dolphin and whale species compared to fish species).

Moreover, gene duplication and whole genome duplication events may generate larger branching patterns of characteristics and adaptive properties in the evolution of species than genetic mutation on its own, or genetic mutation and natural selection on their own (the classic factors of evolution in early 20th century Anglo-American biology).

As suggested, in a population of pure clones, the Darwin-Wallace pattern of constant or near constant ‘perpetuating’ variations across individual organisms is absent. Cloning may reduce the intensity of natural selection by attenuating the Darwin-Wallace pattern of constant or near constant slight variations across individual organisms or biological units; attenuating the Darwin-Wallace pattern, and thereby reducing somewhat the exposure of populations or biological units to natural selection also may be ‘useful’ in generating branching patterns of characteristics and adaptive properties, as in the alternation of generations in the sexual reproduction and asexual reproduction of many plant species, and some animal species, that may be unavailable to populations reproducing purely asexually, or only by sexual reproduction. It has been commented that the asexual reproduction of mitochondria and chloroplasts with their own DNA reduces potential Darwinist and ‘selfish’ genetic competition across the organelle-cell lines, and the clonal reproduction of mitochondria and chloroplasts have contributed to the success of large branching patterns of multi-cellular species in the evolution of life. More generally, cloning is an important force in the evolution of more complex, multi-cellular life; cloning produces branching patterns when there are multiple lines of clones that may be differentiated across functions, as in multiple cell lines that differentiate into the different cell types, tissues, organs, and adaptive structures of complex organisms.

I recognize that this review of ranking forces of nature by their capacity to generate branching patterns is limited, and might include the discussion of other forces of nature in the biological sciences, including the alternation of functions (including the alternation of generations, and the potential alternation of functions across structures, regions, and sections of brains by neurons, or the potential alternation of functions of genes in the genomes of species; it also would include forces such as replication, transcription, and translation, i.e., the replication, transcription, and translation of DNA to RNA to

proteins). However, the presentation of ideas in this paper is to show that it is possible to rank forces of nature by their capacity to generate branching patterns, or, in principle, other fundamental shapes or patterns (such as wavelengths or others). I thus have focused on several forces of nature in the biological sciences, natural selection, gene duplication, cloning, genetic recombination, and assortative mating to show that it is possible to identify different forces of nature in the biological sciences, and order and rank the forces by their capacity to generate branching patterns.

Thus, instead of attempting to unify all of the forces of nature in a single 'theory of everything,' it is possible to classify and separate the forces of nature in relation to each other, and order and rank the forces of nature by their capacity to generate branching patterns. Ranking forces by their capacity to generate branching patterns, in the biological sciences or in the physical sciences, is more positivist and testable than attempts to unify all of the forces of nature in a single theory.

REFERENCES UPON REQUEST